S-112-2006
(Consultant)

MEMORANDUM

TO: Mark Hite, P.E.
Division of Structural Design

FROM: William Broyles, P.E.
Geotechnical Branch Manager

BY: Bart Asher, P.E., P.L.S.
Geotechnical Branch

DATE: December 6, 2006

SUBJECT: **Fayette County**
FD52 034 1927
Mars # 7317901D
KY 1927
Todds Road Widening
Todds Road over I-75 Bridge
Item No. 7-225.00

The geotechnical engineering report for this structure has been completed by L.E. Gregg Associates & Gregg Laboratories. We have reviewed and concur with the recommendations as presented in this report.

A copy of the report is attached. If you have any questions, please contact this office at 502-564-2374.

Attachment:

cc: J. Ballinger
D. Hughes
R. Mills
A. Calvin
B. Greene
Gregory Gabbard (GRW) (w/o attachment)
Eric Haley (L.E. Gregg) (w/o attachment)

L.E. Gregg Associates & Gregg Laboratories

REPORT OF GEOTECHNICAL ENGINEERING INVESTIGATION

TODDS ROAD WIDENING
TODDS ROAD OVER I-75 BRIDGE
ITEM NO. 7-225.00
LEXINGTON, FAYETTE COUNTY, KENTUCKY

Prepared for:
GRW Engineers, Inc.
Lexington, Kentucky

October 27, 2006

Providing Civil Geotechnical Engineering • Forensic • Geological • Materials Testing Services
Since 1957

L. E. GREGG ASSOCIATES/GREGG LABORATORIES

1026 East New Circle Road Lexington, Kentucky 40505 (859) 252-7558 FAX:(859) 255-0940

E-mail: CHaley@legregg.com

October 27, 2006

Mr. Gregory Gabbard, PE
GRW Engineers, Inc.
801 Corporate Drive
Lexington, Kentucky 40503

Re: Report of Geotechnical Engineering Investigation
Todds Road Widening
Todds Road over I-75 Bridge
Item No. 7-225.00
Lexington, Fayette County, Kentucky

Dear Mr.Gabbard:

L. E. GREGG ASSOCIATES is pleased to present our report based on the geotechnical investigation performed at the above referenced site.

This report contains our conclusions and recommendations based on a review of the soil, rock, and water conditions encountered at this site. This report is based on the subsurface exploration and laboratory testing performed by CAE Engineers, Inc. and on available information from the 1961 geotechnical exploration for the existing bridge.

We appreciate the opportunity to assist you on this project. If we can be of further service on this or other projects, please contact us.

Sincerely,
L. E. GREGG ASSOCIATES

Eric C. Haley, PE
Project Engineer

06-048

Attachment

TABLE OF CONTENTS

I

INTRODUCTION

LOCATION AND DESCRIPTION

The Kentucky Transportation Cabinet (KYTC) is planning to widen a portion of KY 1927, Todds Road, in Lexington, Fayette County, Kentucky. As part of these improvements, the existing two-lane four-span Todds Road Bridge over I-75 will be replaced with a four-lane structure. The existing bridge is located approximately 1.6 miles southeast of the Intersection of Man O' War Boulevard and Todds road and crosses over I-75 at approximate milepoint 105.5. Based upon plans submitted to L. E. Gregg Associates by GRW Engineers, Inc., (GRW) of Lexington, Kentucky the bridge begins at Station 105+02.13 and ends at Station 108+27.93. The centerline stationing for the substructure elements are included in Table 1. The proposed new structure will be approximately 326 feet in length. As part of the replacement process, the approach embankments will be widened by approximately 40 feet. The drilling of the site was performed by Central Associated Engineers and Geotechnical Services (CAE).

Table 1. Bridge Substructure Element Stationing

Substructure element	Centerline Stationing
Integral End Bent 1	105+04.03
Pier 1	105+59.03
Pier 2	106+65.03
Pier 3	107+71.03
Integral End Bent 2	108+26.03

SITE GEOLOGY

The site, which can be found on the Geologic Map of the Coletown Quadrangle (USGS USGS 644, 1967), is located near I-75 Mile 105.5 and at the site of the current Todd's Road (KY 1927) overpass.

The area is situated within the Inner Bluegrass Physiographic Region of the state, which is characterized by topography of low to moderate relief, consisting of rolling hills, shallow valleys, and a few sporadically placed sinkholes. Surface drainage from the site is directed toward tributaries to East Hickman Creek, which flows southward to the Kentucky River.

Rocks from the Lexington Limestone formation, a representative of the Upper-Middle Ordovician series, are found beneath the site's soil cover. The Lexington is a thick sequence of interbedded marine carbonate and clastic rocks, which are separated into several lithologically distinct units, or members. The various members of the Lexington Limestone are often found complexly intertongued, and such situations can be somewhat confusing in that several, separate tongues, or lenses, of a specific member can occur wholly within another member.

This intertonguing reflects a mixing of depositional environments that was most likely the result of seasonal, or storm, influences. In any case, the intertonguing often results in the appearance of a "repetitive" lithology, and this seems to be the case at the site. This mixing of lithologies can be clearly observed in nearby highway cuts.

The Tanglewood Limestone Member of the Lexington Limestone is represented at the site by at least two tongues, one occurring between elevations 985-1000 and another between 1030-1045. Both tongues of the Tanglewood are composed of light gray/buff colored, medium to coarse grained, bioclastic limestone (90%) interbedded with hard, dark gray shale (10%). The limestones are generally somewhat thinly cross-bedded, and contain abundant fossil fragments, as well as whole, bryozoan and brachiapod fossils. This unit is very susceptible to groundwater solutioning, and it often has solution-enlarged bedding planes, channels, and pinnacles at its soil/bedrock interface.

Tongues of the Millersburg Member are found between elevations 965-985 and 1000-1030 respectively. The Millersburg is composed of gray, irregularly bedded, fine to medium grained, shaley limestone (50%) with dark gray, calcareous shale (50%). The unit is very fossiliferous throughout, and its shales generally contain both fossils and nodules of fine-grained limestone. It should be pointed out that this unit also contains unusually large fossils, known as stromatoporoids, which tend to average 0.5 to 2.0 feet in thickness, with diameters of 2.0 to 3.0 feet. Ordinarily, such fossils would be of little significance, but since they are composed of much denser and harder limestone than the surrounding host rock, they could pose some problems to drillers. Large, colonial coral fossils are also somewhat abundant. Overall, the Millersburg is fairly susceptible to groundwater solutioning, but it is considerably less so, than the Tanglewood Limestone.

At least one more repetitive occurrence of these same two members is expected below elevation 965, and once again, both units should be composed of the same basic lithologies as described above. In any case, another 150 feet of the lower section of the Lexington Limestone is found below that level.

Although the area's rock units are essentially horizontal and flat lying, there are a few faults found in this area. Numerous, parallel faults, associated with the Lexington/Kentucky River Fault Zone and the Bryan Station Graben, are found about three miles to the west of the site. According to available data, there have been a total of 46 seismic events centered within 100 miles of the site between the years of 1846 and 1987. The strongest of these, was a series of five shocks that occurred approximately 50 miles to the ENE in Bath County in 1980. This event was measured as having an intensity of VII (Modified Mercalli Scale), but apparently caused very little damage.

II

INVESTIGATIVE METHODS

Drilling and sampling was performed by CAE during the month of February, 2006. Boring logs, laboratory test data and other available project information were subsequently turned over to L. E. Gregg. A representative of L. E. Gregg made a site visit on April 25, 2006, to observe existing site conditions.

To determine general descriptions, locations, and thicknesses of the on-site soil strata, a total of seven (7) borings were performed by CAE. However, L. E. Gregg was only provided with logs for four (4) of the borings. To supplement this information, plans for the existing Todds Road over I-75 Bridge were obtained from the KYTC's Division of Structural Design. The plans included drafted boring logs from the 1961 geotechnical exploration for the existing bridge. In addition L. E. Gregg visited the KYTC's Geotechnical Branch office to re-log the rock core obtained from the CAE borings. It is assumed that a truck-mounted auger type drill rig was used to perform this work. In conjunction with this drilling, Standard Penetration Tests were performed to provide a measure of soil consistency and to provide samples for laboratory testing.

The recovered soil samples were returned to CAE's laboratory where classification and other physical property tests were performed on representative samples in general accordance with applicable AASHTO standards. L. E. Gregg subsequently calculated and compiled the test results provided by CAE.

Subsurface Data Sheet 1 of 2 included in Appendix B depicts the layout of the substructure and the boring locations. A summary of information obtained from the borings is presented in Table 2. below (all measurements are expressed in feet).

Table 2. Boring Summary

Hole No.	Station/Offset	Surface Elevation	Top of Rock Elevation	Refusal/ Begin Core Elevation	Length of Core	Bottom of Hole Elevation
Integral End Bent 1						
B-6	105+28.5, 24.5' Rt.	1048.4	1020.1	1020.1	10.0	1010.1
CH-10	105+10.6, 2.0' Lt.	1033.6	1021.1	1021.1	5.0	1016.1
Pier 1						
B-8	106+00.0, 45.0' Rt.	1019.3	1017.9	1017.9	10.0	1007.9
AH-8	105+75.5, 2.5' Lt.	1031.1	1018.8	1018.8	NA	1018.8
CH-7	105+98.2, 25.9' Rt.	1029.4	1018.9	1018.9	5.5	1013.4
Pier 2						
CH-6	106+69.3, 5.4' Rt.	1030.2	1016.2	1016.2	6.0	1010.2
AH-5	105+85.6, 26.9' Rt.	1026.6	1020.1	1020.1	NA	1020.1

Table 2. Boring Summary

Hole No.	Station/Offset	Surface Elevation	Top of Rock Elevation	Refusal/ Begin Core Elevation	Length of Core	Bottom of Hole Elevation
Pier 3						
CH-3	107+72.7, 26.0' Rt.	1026.5	1015.1	1015.1	10.0	1005.1
AH-4	106+45.1, 9.1' Lt.	1029.9	1019.9	1019.9	NA	1019.9
Integral End Bent 2						
B-11	108+05.0, 66.9' Lt.	1035.2	1017.9	1017.9	10.0	1017.7
B-12	108+50.6, 24.0' Rt.	1042.2	1014.2	1014.2	10.0	1004.2
CH-2	108+27.1, 2.0' Lt.	1029.7	1017.7	1017.7	5.0	1012.7

Borings B-6, B-8, B-11 and B-12 were drilled by CAE. Borings CH-2, CH-3, CH-6, CH-7, CH-10, AH-4, AH-5 and AH-8 were drilled by others for the geotechnical exploration of the existing Todds Road over I-75 Bridge.

III

INVESTIGATIVE RESULTS

SOIL CONDITIONS

The results of the field exploration indicate soil depths in the borings range from 1.4 feet in B-8 to 28.3 feet in B-6. The soils encountered at the site generally consisted of fat clays with varying amounts of sand, lean clays, silts and elastic silts. The laboratory testing performed by CAE and compiled by L. E. Gregg on samples recovered from borings B-6, B-11 and B-12 is summarized in Table 3. It should be noted that specific gravity testing was not made available to L. E. Gregg, therefore a value of 2.74 was estimated for calculation purposes.

Table 3. Labortory Testing Summary

Boring No.	Sample Number	USCS Classification	AASHTO Classification	Liquid Limit	Plastic Limit	Plasticity Index
B-6	1	CL	A-7-6(26)	49	23	26
B-6	4	MH	A-7-5(36)	66	34	32
B-11	1	ML	A-4(4)	34	31	3
B-11	3	CL	A-7-6(18)	43	23	20
B-12	6	CH	A-7-6(25)	51	27	24

Detailed results of the laboratory testing can be found in Appendix C and graphical representations of the borings including Standard Penetration Test Blow Counts (N) can be found on the subsurface data sheets in Appendix B.

ROCK CONDITIONS

The rock cores revealed that locally the underlying bedrock is limestone described as gray, medium grained, thin bedded and containing occasional shale partings.

Auger refusal was encountered in the borings ranging in depth from 1.4 feet in boring B-8 to 28.3 feet in boring B-6. Standard and Kentucky Method Rock Quality Designation (RQD) values ranged from 0 to 38 percent. Rock core recoveries ranged from 20 to 100 percent. The 0 RQD and 20 percent recovery values were observed in the initial coring run of Boring B-8. It is likely that this run was initiated in highly weathered soil-like material.

WATER CONDITIONS

A visual reconnaissance of the site revealed that the surface runoff over the site is directed toward I-75. This reconnaissance did not reveal the presence of any ponded water or wet, soft surface areas.

Subsurface water conditions observed in the borings were not noted on the boring logs

provided by CAE, therefore it is our assumption that groundwater was not encountered in the borings. It should be noted that water levels and/or conditions may vary considerably with time, according to the prevailing climate, rainfall or other factors and are otherwise dependent on the duration of and methods used in the exploration program.

The determined natural moisture contents for the Standard Penetration Test samples varied from a low of 11 percent (B-6/Sample 7) to a high of 34 percent (B-6/Sample 4). The average natural moisture content based upon the nineteen (19) samples was determined to be 23 percent.

IV

ENGINEERING ANALYSES

EMBANKMENT STABILITY ANALYSES

Embankment stability analyses were performed by CAE as part of the roadway geotechnical exploration. The bridge spill through slope was evaluated for both the short- and long-term cases. Analyses performed by CAE yielded a short-term factor of safety of 2.6 and a long-term factor of safety of 1.9. The KYTC requires minimum factors of safety of 1.2 for short-term analyses and 1.6 for long-term analyses for bridge approach slopes. Therefore the analyses performed by CAE meet the criteria set forth by the KYTC for both short- and long-term factors of safety. These analyses are graphically represented on the included stability section sheet by CAE in Appendix A.

SETTLEMENT ANALYSES

Based on the boring information provided by CAE and project plans provided by GRW, it appears that new embankment construction will consist of widening of the existing embankment on both sides of the road. These additions to the existing embankment will be constructed on fairly shallow foundation soils. Therefore settlement analyses were not performed for the approach embankments.

PILE DRIVING ANALYSES

The approach embankments for this structure will likely utilize end-bearing driven piles as the foundation system of choice at the integral end bent locations. Based on the provided plans and profiles, it is estimated that piles will be installed through up to 28 feet of soils.

Static pile analyses were conducted by L.E. Gregg at Integral End Bent 1 location utilizing the soil profile depicted on the stability section sheet provided by CAE, and included in Appendix A. These analyses provide an estimate of the ultimate driving resistance that 12-inch steel H-piles would experience during the installation process, using guidelines set forth in the FHWA "Soils and Foundations Workshop Manual".

Based on available bridge profiles and the subsurface conditions indicated on the logs of borings, the soil profile contributing to driving resistance will include embankment material and foundation soils from the existing ground surface down to bedrock. The results of FHWA research indicate that significant reductions in skin resistances occur during the pile driving process due to the dynamics of the installation process. The KYTC suggests reductions in skin resistance of 50 percent for clay materials and 25 percent for sands should be applied when estimating driving resistances.

The computer program DRIVEN, developed by the FHWA was utilized to estimate the ultimate driving resistances. Based on this analysis, ultimate driving resistances on the order of 30 tons will be experienced while driving the pile to a depth of approximately 28 feet. FHWA

literature suggests that a pile hammer capable of delivering approximately 5 foot-kips of energy will be necessary to overcome driving resistances of 30 tons. The KYTC Standard Specifications for Road and Bridge Construction, current edition, recommends a minimum pile hammer energy of 10 foot-kips. Therefore any commercially available pile hammer capable of delivering 10 foot-kips of driving energy should be suitable for pile installation.

V

NOTES AND RECOMMENDATIONS

APPROACH EMBANKMENT CONSTRUCTION

The approach embankments shall be constructed with pile cores at all applicable substructure element locations to facilitate installation of the foundation systems. Construction of the pile cores shall be in accordance with KYTC Special Provision No. 69, Standard Drawing Nos. RGX-100 and RGX-105, and Section 206 of the current Kentucky Department of Highways Standard Specifications for Road and Bridge Construction.

GENERAL FOUNDATION CONSIDERATIONS

Based on review of available boring information and anticipated structural loading, it is recommended that all substructure foundation elements be rock bearing. Table 4. provides available foundation options, using the following notations:

a = Rock bearing spread footings
b = End bearing steel H-piles driven to refusal on bedrock
c = Rock bearing drilled shafts

The foundation options shown in Table 4 are those which L.E. Gregg considers to be most feasible. Specific site conditions, construction and economic considerations may decide which option is most desirable.

Table 4. Foundation Options

Substructure Element / Boring Number	Station and Offset	Foundation Option	Top of Rock Elevation (feet)*	Estimated Foundation Bearing Elevation	Estimated Allowable Bearing Pressure (psf)
Integral End Bent 1					
B-6	105+28.5, 24.5' Rt.	b	1020.1	1020.0	---
		c		1018.0	30,000
CH-10	105+10.6, 2.0' Lt.	b	1021.1	1021.0	---
		c		1019.0	30,000
Pier 1					
B-8	106+00.0, 45.0' Rt.	a	1017.9	1014.0	20,000
		c		1012.0	30,000
AH-8	105+74.5, 2.5' Lt.	a	1018.8	1014.0	20,000
		c		1012.0	30,000
CH-7	105+98.2, 25.9' Rt.	a	1018.9	1014.0	20,000

Table 4. Foundation Options

Substructure Element / Boring Number	Station and Offset	Foundation Option	Top of Rock Elevation (feet)*	Estimated Foundation Bearing Elevation	Estimated Allowable Bearing Pressure (psf)
CH-7	105+98.2, 25.9' Rt	c	1018.9	1012.0	30,000
Pier 2					
CH-6	106+69.3, 5.4' Rt.	a	1016.2	1012.5	20,000
		c		1012.5	30,000
AH-5	105+85.6, 26.9' Rt.	a	1020.1	1012.5	20,000
		c		1012.5	30,000
Pier 3					
AH-4	106+45.1, 9.1' Lt.	a	1019.9	1010.0	20,000
		c		1008.0	30,000
CH-3	107+72.7, 26.0' Rt.	a	1015.1	1010.0	20,000
		c		1008.0	30,000
Integral End Bent 2					
B-11	108+05.0, 66.9' Lt.	b	1017.9	1017.5	---
		c		1012.0	30,000
B-12	108+50.6, 24.0' Rt.	b	1014.2	1014.0	---
		c		1012.0	30,000
CH-2	108+27.1, 2.0' Lt.	b	1017.7	1017.5	---
		c		1012.0	30,000

* Top of Rock as used above refers to rock-like resistance to augering. This may indicate the presence of weathered bedrock, boulders or rock slabs. An accurate determination of the top of rock cannot be made without performing rock coring.

The estimated pile tip elevations and bearing elevations for spread footings and drilled shafts are based upon visual examination of recovered rock cores and available subsurface information from the geotechnical exploration of the existing Todds Road over I-75 Bridge. Final bearing elevations may vary at locations where borings have not been performed.

ROCK BEARING SPREAD FOOTINGS

1. Rock bearing spread footings are being provided as foundation options for Piers 1, 2 and 3. Depending on bedrock weathering conditions and site topography, additional rock excavation may be necessary to achieve suitable bearing conditions.

2. The bearing surfaces of the spread footings should be level and any soft compressible materials should be removed prior to placement of reinforcing steel and concrete.

END BEARING STEEL H-PILES

1. Hammer energies on the order of 5 foot-kips are needed to overcome the ultimate driving resistances encountered by a 12-inch steel H-pile to refusal on bedrock. It is recommended that a pile hammer capable of delivering a minimum energy of 10 foot-kips be utilized to drive the 12 x 53 steel H-piles, per Section 604 of the Kentucky Standard Specifications for Road and Bridge Construction, current edition.

2. If end bearing steel H-piles are the foundation option of choice, the Designer should place a note on the plans that states: Any commonly used pile hammer allowed by the KYTC Division of Construction should be adequate to drive the piles to bedrock without encountering excessive blow counts and over-stressing the piles. The contractor shall submit appropriate pile driving systems to the KYTC for approval prior to installation of the first pile. Approval of the pile driving system by the Engineer will be subject to satisfactory field performance of the pile driving procedures.

3. The capacity of steel H-piles driven to refusal on bedrock may be based upon an allowable stress of 0.25 Fy over the cross sectional area of the pile, not including the area of any tip reinforcement, as per the AASHTO Standard Specifications for Highway Bridges, current edition.

4. Pile types, driving systems and installation methods should conform to current AASHTO Standard Specifications for Highway Bridges, unless otherwise specified.

6. The KYTC requires that protective pile points be used on all piles. The pile points should be installed according to Section 604 of the Kentucky Standard Specifications for Road and Bridge Construction, current edition.

ROCK BEARING DRILLED SHAFTS

1. All drilled shaft construction shall be performed in accordance with the current KYTC "Special Note for Drilled Shafts".

2. Embed the shafts into unweathered bedrock a minimum of 1.5 times the rock socket diameter.

3. If drilled shafts become a viable foundation option, contact L.E. Gregg as soon as possible with the proposed shaft layout. If the designer can provide a range of shaft sizes to investigate, then idealized soil profiles for Lateral Analyses and capacity tables can be generated for final design.

4. Permanent casing is required in the overburden. It should be noted on the plans that the permanent casing should be incidental to the unit bid price for Drilled Shaft, Common.

5. Additional drilling may be required prior to and/or during construction to finalize the drilled shaft bearing elevations. If drilled shafts are selected, the need for additional drilling will be evaluated after reviewing the shaft layout and details.

VI

LIMITATIONS

VARIATIONS

Since any general foundation or subsurface investigation can examine and report only that information which is obtained from the borings and samples taken therefrom, and since uniformity of subsurface conditions does not always exist, we offer this further recommendation. If, during construction, any latent soil, bedrock, or water conditions are encountered that were not observed in the borings, contact us in order that we may inspect the site and make any modifications in the design or construction of the foundation that may be necessary.

OTHER INTERPRETATIONS

The conclusions and recommendations submitted in this report apply to the proposed project only. They are not applicable to on-site, subsequent construction, adjacent or nearby projects. In the event that conclusions or recommendations based on this report and relating to any other projects are made by others, such conclusions and recommendations are not the responsibility of L. E. Gregg Associates.

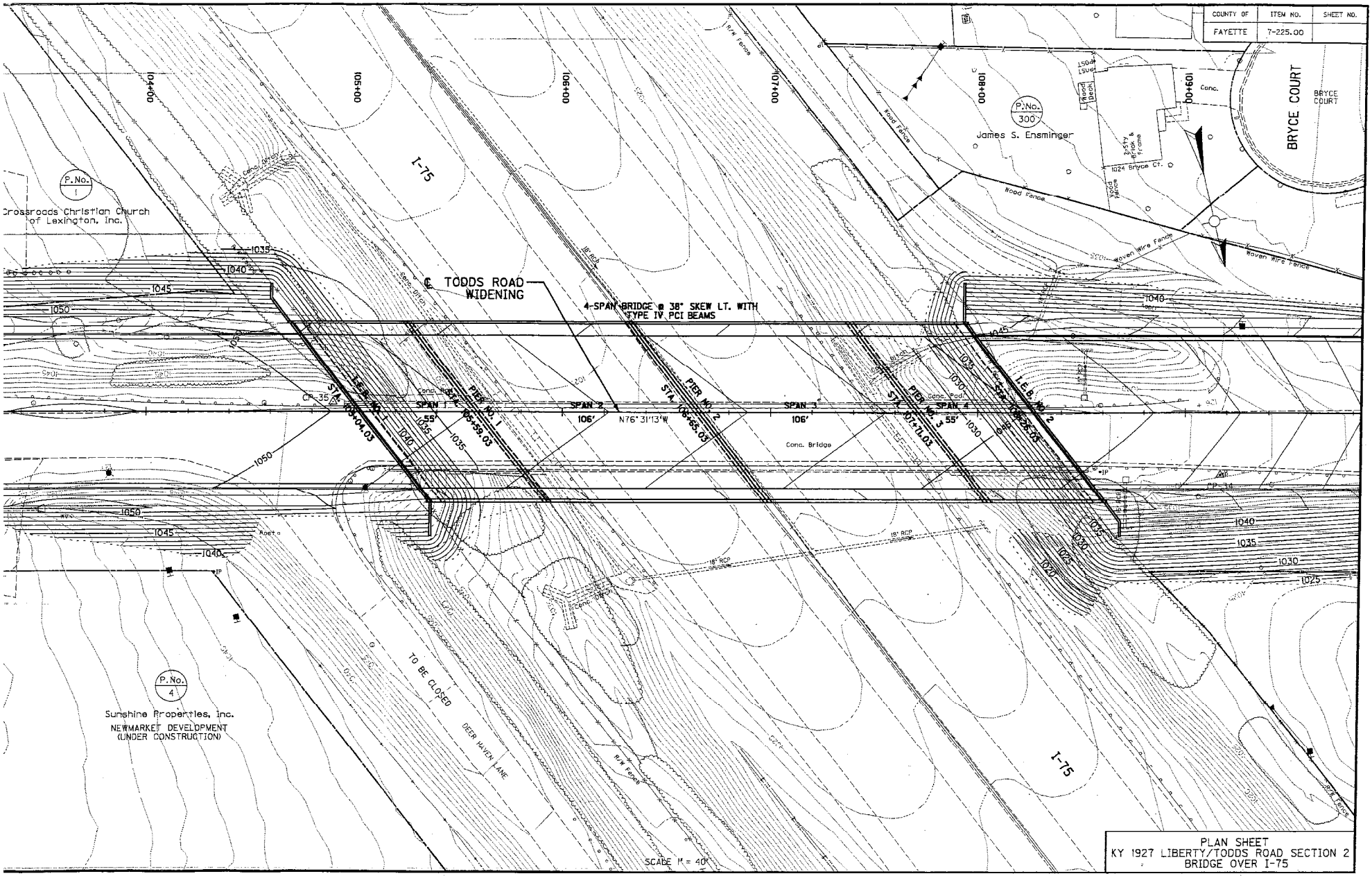
All structure details shown herein are for illustrative purposes only and may not be indicative of the final design conditions shown in the contract plans.

STANDARD OF CARE

The services provided by L. E. Gregg Associates for this investigation have been performed in a manner consistent with that degree of care and skill ordinarily exercised by members of the same profession currently practicing under similar circumstances.

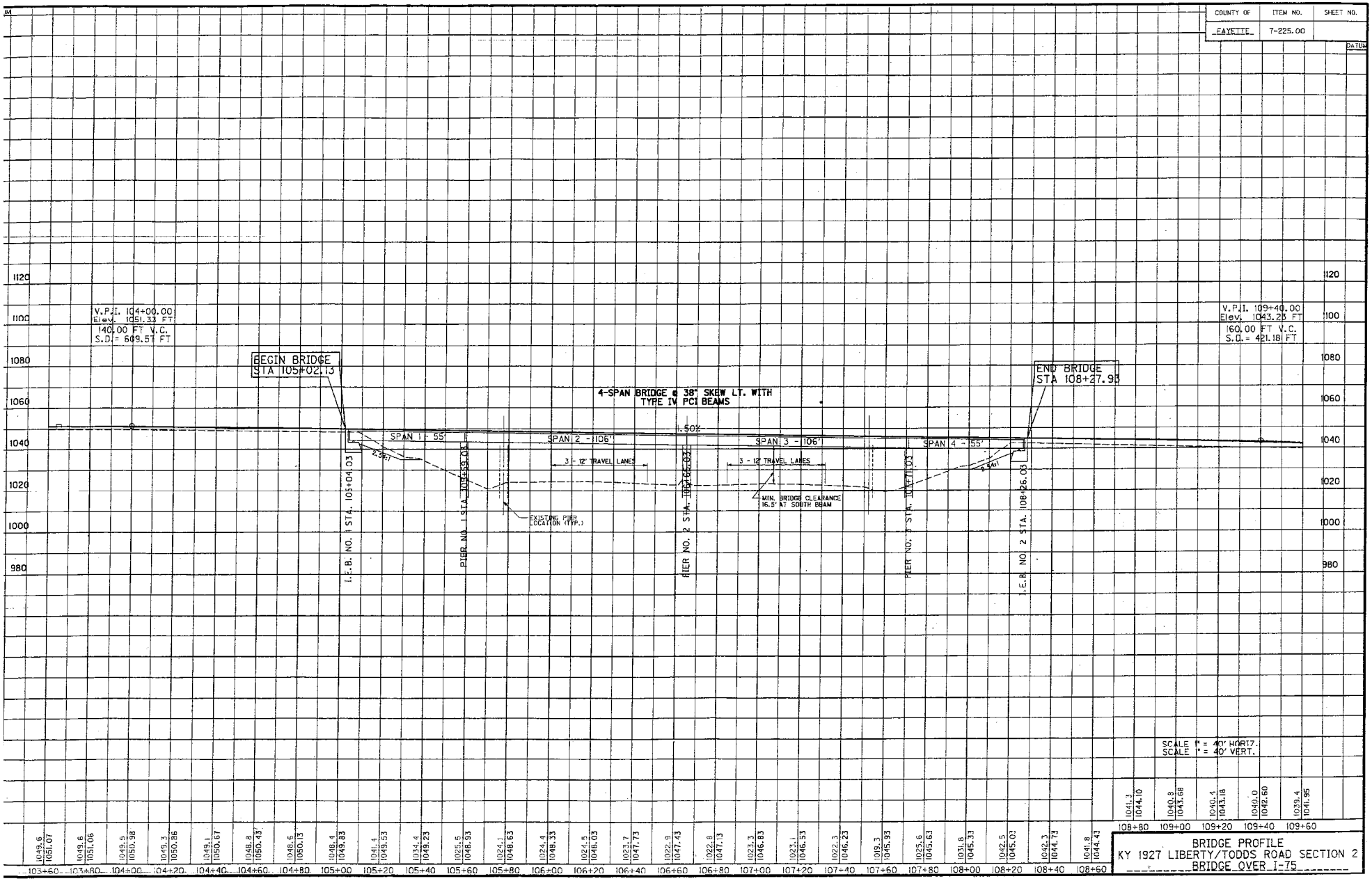
APPENDIX A

PRELIMINARY PLAN, PROFILE AND STABILITY SHEETS PROVIDED BY GRW, ENGINEERS INC.


COUNTY OF
FAYETTE
ITEM NO.
7-225.00
SHEET NO.
TODDS ROAD WIDENING
4-SPAN BRIDGE @ 38° SKEW LT. WITH TYPE IV PCI BEAMS
I-75
BRYCE COURT
James S. Ensminger
P.No. 300
Crossroads Christian Church of Lexington, Inc.
P.No. 1
Sunshine Properties, Inc.
NEWMARKET DEVELOPMENT (UNDER CONSTRUCTION)
P.No. 4
TO BE CLOSED
DEER HAVEN LANE
PIER NO. 1
PIER NO. 2
PIER NO. 3
SPAN 1
SPAN 2
SPAN 3
SPAN 4
106'
55'
N76° 31'13"W
Conc. Bridge
Woven Wire Fence
Wood Fence
R/W Fence
18" RCP
SCALE 1" = 40'
PLAN SHEET
KY 1927 LIBERTY/TODDS ROAD SECTION 2
BRIDGE OVER I-75

COUNTY OF	ITEM NO.	SHEET NO.
FAYETTE	7-225.00	

DATUM



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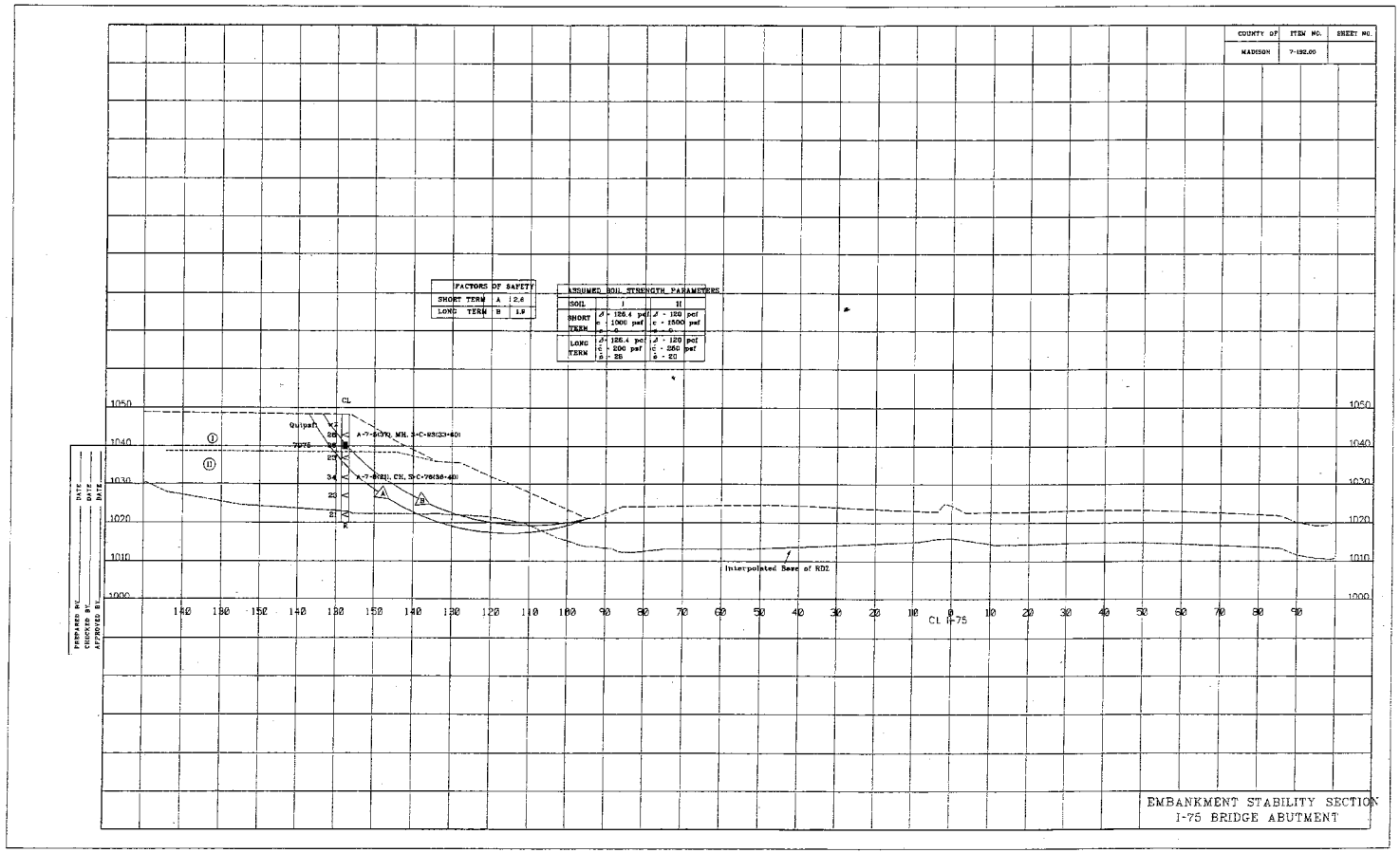
103+60	103+80	104+00	104+20	104+40	104+60	104+80	105+00	105+20	105+40	105+60	105+80	106+00	106+20	106+40	106+60	106+80	107+00	107+20	107+40	107+60	107+80	108+00	108+20	108+40	108+60

SCALE 1" = 40' HORIZ.
SCALE 1" = 40' VERT.

1041.3 1044.10	1040.8 1043.68	1040.4 1043.18	1040.0 1042.60	1039.4 1041.95
108+80	109+00	109+20	109+40	109+60

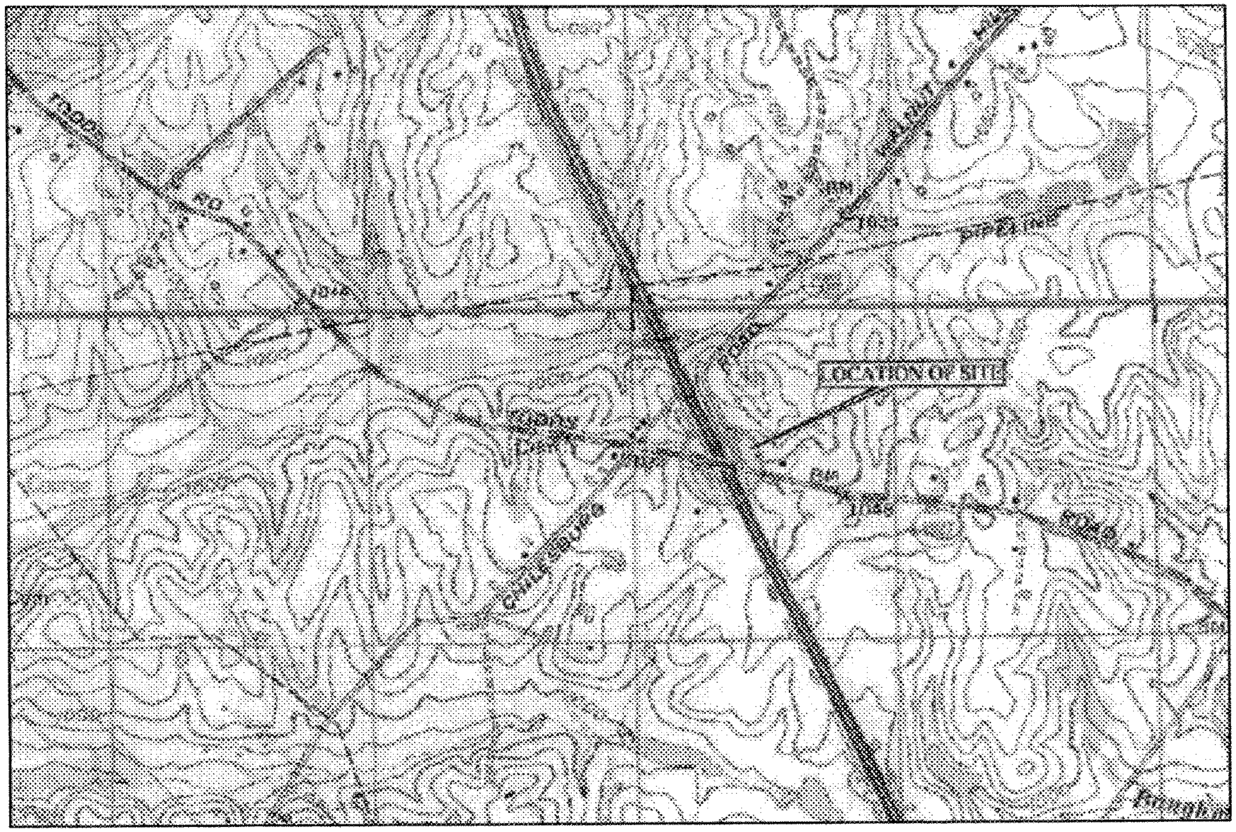
BRIDGE PROFILE
KY 1927 LIBERTY/TODDS ROAD SECTION 2
BRIDGE OVER I-75



A-I-75 EMBANKMENT.dgn 9/27/2006 10:44:34 AM

APPENDIX B

SUBSURFACE DATA SHEETS



SITE LOCATION MAP TODDS ROAD OVER I-75 BRIDGE ITEM NO. 7-225.00 LEXINGTON, FAYETTE CO., KENTUCKY	**L. E. GREGG ASSOCIATES** 446 East High Street - Suite 140 Lexington, Kentucky, 40507 Civil/Geotechnical Engineers & Geologist	job no. 06–048 date: 10–26–06 SHEET: 1 of 1 COMMENTS:	drawn by: KB CHKD BY: ECH SCALE: NTS

GEOTECHNICAL SYMBOL SHEET

COUNTY OF	ITEM NO.	SHEET NO.
COUNTY	0	

PREPARED BY ____ DATE ____
CHECKED BY ____ DATE ____
APPROVED BY ____ DATE ____

AASHTO Classification of Soils and Soil-Aggregate Mixtures

General Classification	Granular Materials (35% or less passing 0.075 mm)							Silt-Clay Materials (More than 35% passing 0.075 mm)			
Group Classification	A-1		A-3	A-2				A-4	A-5	A-6	A-7
	A-1-a	A-1-b		A-2-4	A-2-5	A-2-6	A-2-7				A-7-5 A-7-6
Sieve Analysis, Percent Passing											
2.00 mm (No. 10)	50 max	---	---	---	---	---	---	---	---	---	---
0.425 mm (No. 40)	30 max	50 max	51 min	---	---	---	---	---	---	---	---
0.075 mm (No. 200)	15 max	25 max	10 max	35 max	35 max	35 max	35 max	36 min	36 min	36 min	36 min
Characteristics of Fraction Passing 0.425 mm (No. 40)											
Liquid Limit	---		---	40 max	41 min	40 max	41 min	40 max	41 min	40 max	41 min
Plasticity Index	6 max		N.P.	10 max	10 max	11 min	11 min	10 max	10 max	11 min	11 min

Unified Soil Classifications

MAJOR DIVISIONS		SYMBOL	NAME
COARSE GRAINED SOILS	GRAVEL AND GRAVELLY SOILS	GW	Well-graded gravels or gravel-sand mixtures, little or no fines.
		GP	Poorly graded gravels or gravel-sand mixtures, little or no fines.
		GM	Silty gravels, gravel-sand-silt mixtures.
		GC	Clayey gravels, gravel-sand-clay mixtures.
	SAND AND SANDY SOILS	SW	Well graded sands or gravelly sands, little or no fines.
		SP	Poorly graded sands or gravelly sands, little or no fines.
		SM	Silty sands, sand-silt mixtures.
		SC	Clayey sands, sand-clay mixtures.
FINE GRAINED SOILS	SILTS AND CLAYS LL IS LESS THAN 50	ML	Inorganic silts and very fine sands, rock flour, silty or clayey fine sands or clayey silts with slight plasticity.
		CL	Inorganic clays of low to medium plasticity, gravelly clays, sandy clays silty clays, lean clays.
	SILTS AND CLAYS LL IS GREATER THAN 50	MH	Inorganic silts, micaceous or diatomaceous fine sandy or silty soils, elastic silts.
		CH	Inorganic clays of high plasticity, fat clays.
UNCLASSIFIED MATERIAL		NONE	Non-classified materials (i.e. overburden, pavement, slag, etc.) Include visual description.

AI	Activity Index
LI	Liquidity Index
S+C	Silt + Clay (% finer than No.200 Sieve)
○	Rockline Soundings
◔	Disturbed Sample Boring
◎	Undisturbed Sample Boring
⊙	Undisturbed Sample Boring & Rock Core
●	Rock Core
	Slope Inclinometer Installation
	typical applications:
OW	Observation Well
➡	Approximate Footing Elevation
▼ (Date)	Water Elevation
VS (psf)	Field Vane Shear Strength
■	Thin-walled Tube Sample
<	Standard Penetration Test Sample
N	Penetration Resistance
Qu (psf)	Unconfined Compressive Strength
UU (psf)	Unconsolidated Undrained Triaxial Strength
w%	Moisture Content
KY ROD	Rock Quality Designation (Kentucky Method)
STD ROD	Rock Quality Designation (Standard Method)
REC	Core Recovery
SDI(JS)	Slake Durability Index (Jar Slake Test)
∅	Angle of Internal Friction (Total Stress)
$\overline{\emptyset}$	Angle of Internal Friction (Effective Stress)
c (psf)	Cohesion (Total Stress)
$\overline{c}$ (psf)	Cohesion (Effective Stress)
δ (pcf)	Total Unit Weight
RDZ	Rock Disintegration Zone
OB	Overburden Bench
IB	Intermediate Bench
R	Refusal
NR	Refusal Not Encountered

LIMESTONE

SANDSTONE

DURABLE SHALE (SDI ≥ 95)

NONDURABLE SHALE (SDI < 95)

COAL

TALUS, MINE WASTE, FILL MATERIAL, BOULDERS, & ETC.

GRANULAR EMBANKMENT

STRUCTURE GRANULAR BACKFILL

SLOPE PROTECTION

GEOTECHNICAL SYMBOL SHEET

USER: $$$$USERS$$$$
DATE: $$$$DATE$$$$
FILE NAME: $$$$designatedfile$$$$specification$$$$
E-SHEET NAME:

GEOTECHNICAL NOTES

COUNTY OF	ITEM NO.	SHEET NO.
COUNTY	0	

PREPARED BY _____ DATE _____
CHECKED BY _____ DATE _____
APPROVED BY _____ DATE _____

APPROACH EMBANKMENT CONSTRUCTION

The approach embankments shall be constructed with pile cores at all applicable substructure element locations to facilitate installation of the foundation systems. Construction of the pile cores shall be in accordance with KYTC Special Provision No. 69, Standard Drawing Nos. RGX-100 and RGX-105, and Section 206 of the current Kentucky Department of Highways Standard Specifications for Road and Bridge Construction.

ROCK BEARING SPREAD FOOTINGS

1. Rock bearing spread footings are being provided as foundation options for Piers 1, 2 and 3. Depending on bedrock weathering conditions and site topography, additional rock excavation may be necessary to achieve suitable bearing conditions.

2. The bearing surfaces of the spread footings should be level and any soft compressible materials should be removed prior to placement of reinforcing steel and concrete.

END BEARING STEEL H-PILES

1. Hammer energies on the order of 5 foot-kips are needed to overcome the ultimate driving resistances encountered by a 12-inch steel H-pile to refusal on bedrock. It is recommended that a pile hammer capable of delivering a minimum energy of 10 foot-kips be utilized to drive the 12 x 53 steel H-piles, per Section 604 of the Kentucky Standard Specifications for Road and Bridge Construction, current edition.

2. If end bearing steel H-piles are the foundation option of choice, the Designer should place a note on the plans that states: Any commonly used pile hammer allowed by the KYTC Division of Construction should be adequate to drive the piles to bedrock without encountering excessive blow counts and over-stressing the piles. The contractor shall submit appropriate pile driving systems to the KYTC for approval prior to installation of the first pile. Approval of the pile driving system by the Engineer will be subject to satisfactory field performance of the pile driving procedures.

3. The capacity of steel H-piles driven to refusal on bedrock may be based upon an allowable stress of 0.25 Fy over the cross sectional area of the pile, not including the area of any tip reinforcement, as per the AASHTO Standard Specifications for Highway Bridges, current edition.

4. Pile types, driving systems and installation methods should conform to current AASHTO Standard Specifications for Highway Bridges, unless otherwise specified.

6. The KYTC requires that protective pile points be used on all piles. The pile points should be installed according to Section 604 of the Kentucky Standard Specifications for Road and Bridge Construction, current edition.

Commonwealth of Kentucky
DEPARTMENT OF HIGHWAYS
COUNTY OF
FAYETTE

PROJECT NUMBERS: 7-225.00

GEOTECHNICAL NOTES

USER: $$$$USER$$$$
DATE: $$$$DATE$$$$
FILE NAME: $$$$design$$file$$specification$$$$
E-SHEET NAME:

SHEET LOCATION:

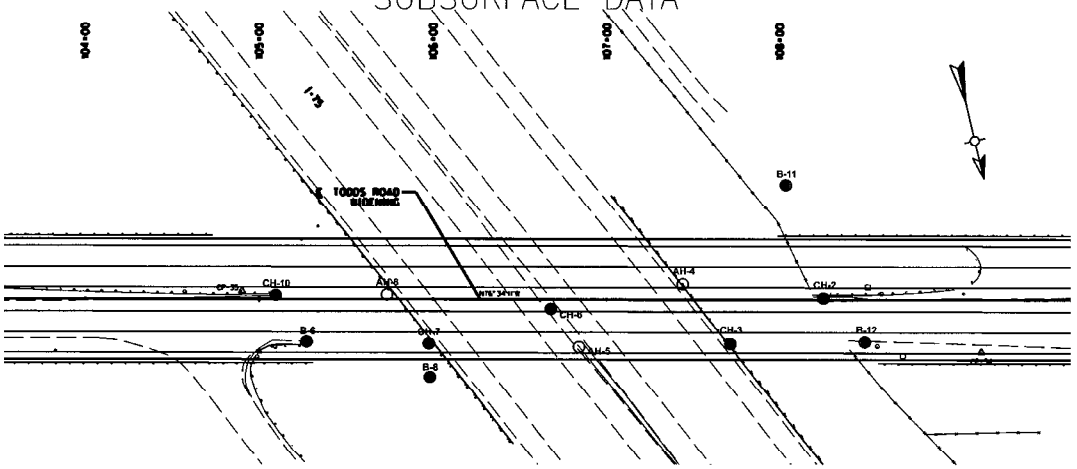
FILE NAME: $$$$design$$file$specifications$$$$

USERNAME: $$$$USER$$$$

DATE: $$$$DATE$$$$

E-SHEET NAME:

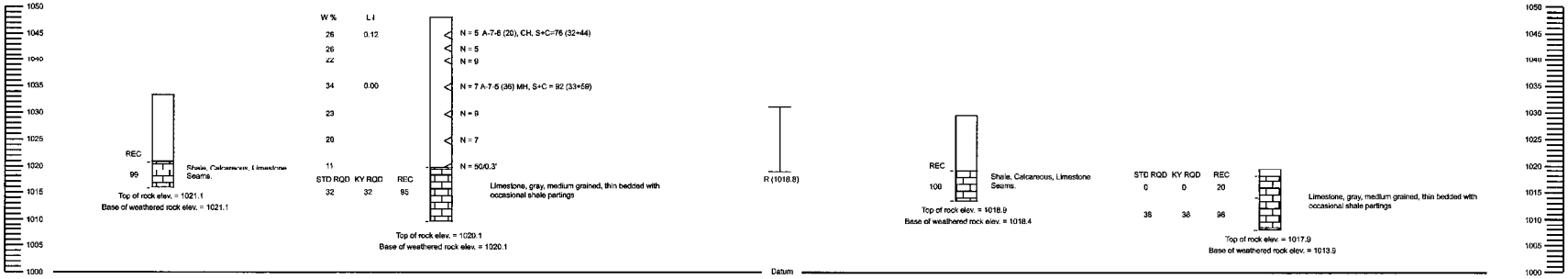
SUBSURFACE DATA



Integral End Bent 1 — Pier 1

Approximate Roadway Grade Elev. = 1049.8

Hole No.	CH-10	B-6	AH-8	CH-7	B-8
Station	105+10.5	105+28.5	105+74.5	105+98.2	106+00.0
Offset	2' Lt.	24.5' Rt.	2.5' Lt.	25.9' Rt.	45' Rt.
Elev.	1033.6	1048.4	1031.1	1029.4	1019.3



Profile Scale :
Vertical 1" = 10'
Horizontal not to scale

Holes with an "AH" or "CH" designation are borings from the original structure plans dated 1961.

The allowable bearing capacity for spread footings on sound bedrock is 20,000 psf.

Sheet 1 of 2

DATE: August, 2006	CHECKED BY
DESIGNED BY:	
DETAILED BY: KB/DH	ECH

Commonwealth of Kentucky
DEPARTMENT OF HIGHWAYS

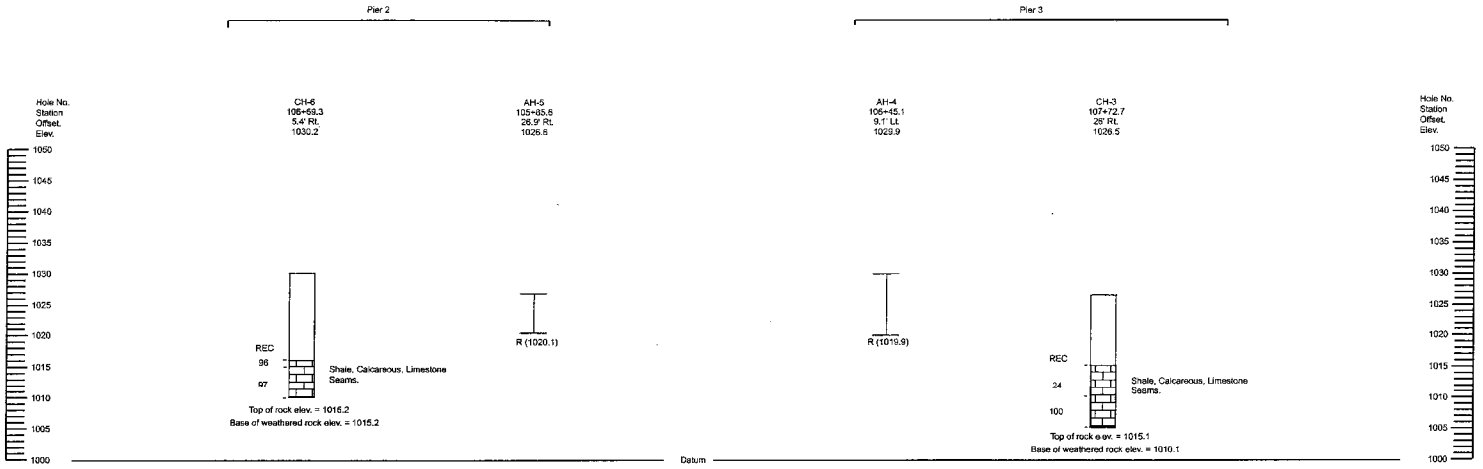
COUNTY: FAYETTE

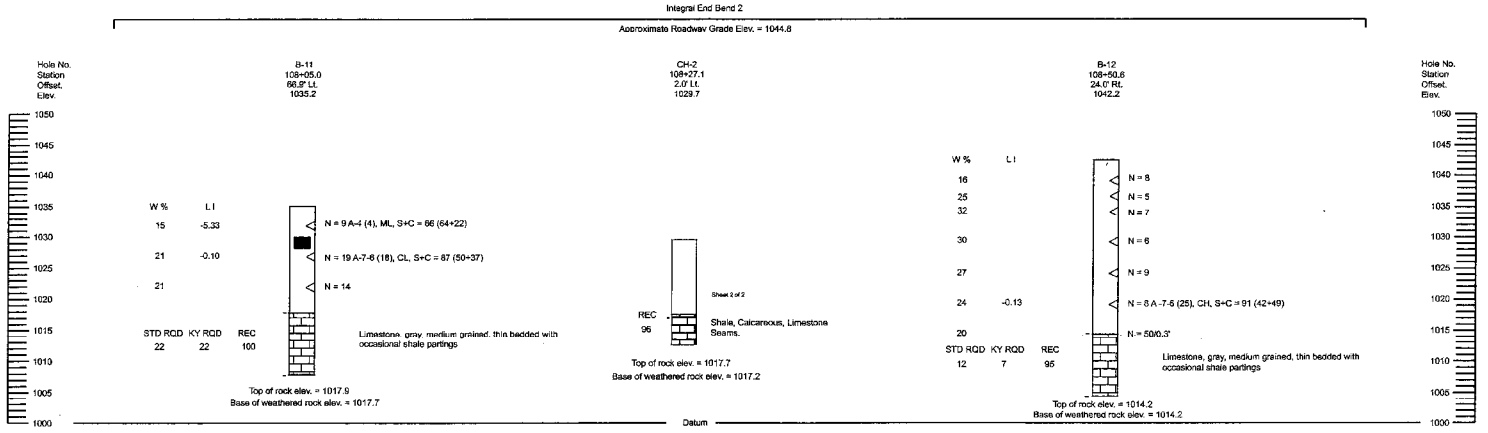
ROUTE	CROSSING
KY 1927	I-75

LAYOUT AND LOGS OF BORINGS

ITEM NUMBER	PREPARED BY	SHEET NO.
7-225.00	L. E. GREGG ASSOCIATES	DRAWING NO.

SUBSURFACE DATA





Profile Scale :
Vertical 1" = 10'
Horizontal not to scale

Holes with an "AH" or "CH" designation are borings from the original structure plans dated 1961.

The allowable bearing capacity for spread footings on sound bedrock is 20,000 psf.

DATE: August, 2006	CHECKED BY
DESIGNED BY:	
DETAILED BY: KB/DH	ECH

Commonwealth of Kentucky
DEPARTMENT OF HIGHWAYS

COUNTY: FAYETTE

ROUTE	CROSSING
KY 1927	I-75

LAYOUT AND LOGS OF BORINGS

ITEM NUMBER	PREPARED BY	SHEET NO.
7-225.00	L. E. GREGG ASSOCIATES	DRAWING NO.

SHEET LOCATION:
FILE NAME: $$$$designs\file4spec1fication$$$$
USERNAME: $$$$USER$$$$
DATE: $$$$DATE$$$$
E-SHEET NAME:

APPENDIX C

LOGS OF BORINGS

LABORATORY TESTING RESULTS

COORDINATE DATA SUBMISSION SHEET

Subsurface Log

L.E. Gregg Associates & Gregg Laboratories

L.E. Gregg Project No. 06-048

County	Fayette	Item No.	7-225.00	Location	105+28.5, 24.5' Rt.
				Hole No.	B-6
				Total Depth	38.3
				Latitude	
				Longitude	
Road Name	Todds Road Bridge over I-75			Surface Elevation	1048.4
Roadway or Structure:	Structure			Date Started	2/21/06
				Completed	2/21/06
Supervisor	CAE	Driller	Rick Sparks	Depth to Water	---
				Date/Time	---
Logged By	CAE / C. Haley - L.E. Gregg			Depth to Water	---
				Date/Time	---

Lithology			Overburden	Sample #	Depth (ft)	Rec. (ft)	SPT Blows	Type	
Elevation	Depth	Description	Rock Core	KY-RQD %	Run (ft)	Rec. (ft)	Rec. %	SDI	Remarks
1048.4	0.0	Top of Boring							
		Overburden		1	2.5 - 4.0	1.1	1-2-3	SPT	
				2	5.0 - 6.5	1.2	2-2-3	SPT	
				3	7.5 - 9.0	0.9	3-4-5	SPT	
				4	12.5 - 14.0	1.1	2-3-4	SPT	
				5	17.5 - 19.0	0.9	3-5-4	SPT	
				6	22.5 - 24.0	1.2	5-3-4	SPT	
1020.1	28.3	Auger Refusal / Begin Core		7	27.5 - 28.3	0.5	19-50/0.3'	SPT	
		Limestone, gray, medium grained, thin bedded, with occasional shale partings		RQD KY/STD					Base of Weathered Rock = 28.3'
1010.1	38.3			32/32	28.3 - 38.3	9.5	95	NQ	
		Bottom of Boring							

L.E. Gregg & Gregg Laboratories

Subsurface Log

L.E. Gregg Project No. 06-048

County	Fayette	Item No.	7-225.00	Location	106+00, 45' Rt.
				Hole No.	B-8
				Total Depth	11.4
				Latitude	
				Longitude	
Road Name	Todds Road Bridge over I-75			Surface Elevation	1019.3
Roadway or Structure:	Structure			Date Started	2/22/06
				Completed	2/22/06
Supervisor	CAE	Driller	Rick Sparks	Depth to Water	---
				Date/Time	---
Logged By	CAE / C. Haley - L.E. Gregg			Depth to Water	---
				Date/Time	---

Lithology Elevation	Lithology Depth	Description	Overburden / Rock Core	Sample # / KY-RQD %	Depth (ft) / Run (ft)	Rec. (ft) / Rec. %	SPT Blows / SDI	Remarks
1019.3	0.0	Top of Boring						
		Overburden						
1017.9	1.4	Auger Refusal / Begin Core						
		Limestone, gray, medium grained, thin bedded, with occasional shale partings		RQD KY/STD				Base of Weathered Rock = 5.4'
1012.9	6.4			0/0	1.4 - 6.4	1.0	20 NQ	
1007.9	11.4			38/38	6.4 - 11.4	4.9	98 NQ	
		Bottom of Boring						

L.E. Gregg & Gregg Laboratories

Subsurface Log

L.E. Gregg Project No. 06-048

County	Fayette	Item No.	7-225.00
Location	108+05.0, 66.9' Lt.		
Hole No.	B-11	Total Depth	27.3
Latitude		Longitude	
Road Name	Todds Road Bridge over I-75	Surface Elevation	1035.2
Roadway or Structure:	Structure	Date Started	2/22/06
Completed	2/22/06		
Supervisor	CAE	Driller	Rick Sparks
Depth to Water	---	Date/Time	---
Logged By	CAE / C. Haley - L.E. Gregg	Depth to Water	---
Date/Time	---		

Lithology Elevation	Lithology Depth	Description	Overburden / Rock Core	Sample # / KY-RQD %	Depth (ft) / Run (ft)	Rec. (ft) / Rec. %	SPT Blows	Type / SDI	Remarks
1035.2	0.0	Top of Boring							
1034.5	0.7	Topsoil		1	2.5 - 4.0	1.1	3-4-5	SPT	
		Overburden		2	5.0 - 7.0	2.0	100	ST	
				3	7.5 - 9.0	1.5	8-8-11	SPT	
				4	12.5 - 14.0	1.5	5-6-8	SPT	
1017.9	17.3	Auger Refusal / Begin Core							
		Limestone, gray, medium grained, thin bedded, with occasional shale partings		RQD / KY/STD					Base of Weathered Rock = 17.5'
1007.9	27.3			22/22	17.3 - 27.3	10.0	100	NQ	
		Bottom of Boring							

L.E. Gregg & Gregg LABORATORIES

Subsurface Log

L.E. Gregg Project No. 06-048

County Fayette | Item No. 7-225.00 | Location 108+50.57, 24.0; Rt.

Hole No. B-12 | Total Depth 38.0

Latitude | Longitude

Road Name Todds Road Bridge over I-75 | Surface Elevation 1042.2

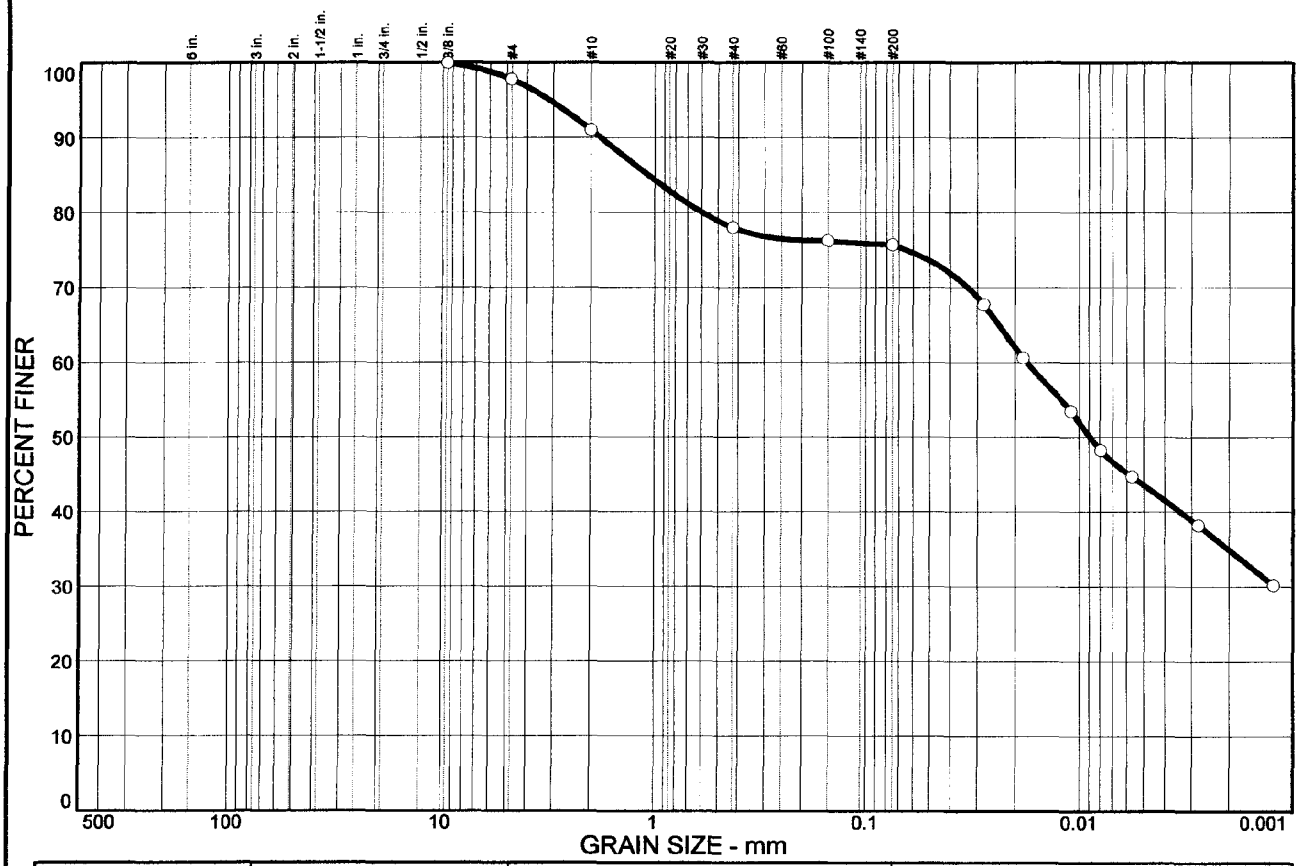
Roadway or Structure: Structure | Date Started 2/20/06 | Completed 2/20/06

Supervisor CAE | Driller Rick Sparks | Depth to Water --- | Date/Time ---

Logged By CAE / C. Haley - L.E. Gregg | Depth to Water --- | Date/Time ---

Lithology Elevation	Lithology Depth	Description	Overburden / Rock Core	Sample # / KY-RQD %	Depth (ft) / Run (ft)	Rec. (ft) / Rec. %	SPT Blows / SDI	Type	Remarks
1042.2	0.0	Top of Boring							
		Overburden		1	2.5 - 4.0	0.1	2-3-5	SPT	
				2	5.0 - 6.5	0.2	3-5-3	SPT	
				3	7.5 - 9.0	0.9	2-2-5	SPT	
				4	12.5 - 14.0	0.9	3-2-4	SPT	
				5	17.5 - 19.0	0.2	3-4-5	SPT	
				6	22.5 - 24.0	1.2	2-3-5	SPT	
1014.2	28.0	Auger Refusal / Begin Core		7	27.5 - 28.0	0.3	19-50/0.3'	SPT	
		Limestone, gray, medium grained, thin bedded, with occasional shale partings		RQD KY/STD					Base of Weathered Rock = 28.0'
1004.2	38.0			7/12	28.0 - 38.0	9.5	95	NQ	
		Bottom of Boring							

Particle Size Distribution Report



% COBBLES	% GRAVEL		% SAND			% FINES	
	CRS.	FINE	CRS.	MEDIUM	FINE	SILT	CLAY
0.0	0.0	2.2	6.8	13.0	2.3	32.1	43.6

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
3/8 in.	100.0		
#4	97.8		
#10	91.0		
#40	78.0		
#100	76.2		
#200	75.7		

* (no specification provided)

Material Description

Lean Clay with Sand

Atterberg Limits

PL= 23 LL= 49 PI= 26

Coefficients

D_{85}= 1.08 D_{60}= 0.0177 D_{50}= 0.0089
D_{30}= D_{15}= D_{10}=
C_u= C_c=

Classification

USCS= CL AASHTO= A-7-6(20)

Remarks

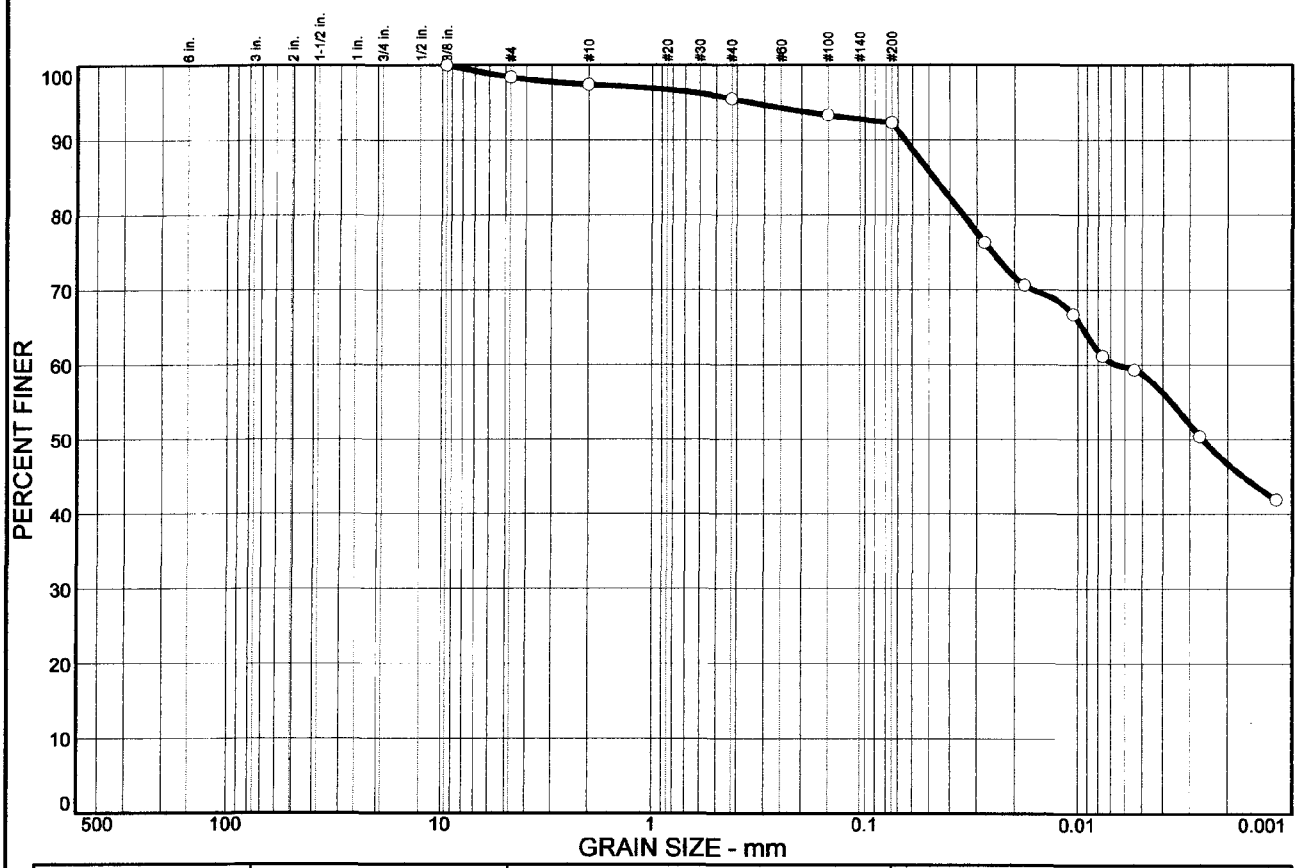
A Specifc Gravity of 2.74 was assumed for Hydrometer calculations
F.M.=0.26

Sample No.: **Source of Sample:** **Date:**
Location: B-6 Sample #1 **Elev./Depth:**

GREGG LABORATORIES, INC.

Client: GRW Engineering
Project: Todds Road Bridge
Project No: 06-048 **Figure**

Particle Size Distribution Report



% COBBLES	% GRAVEL		% SAND			% FINES	
	CRS.	FINE	CRS.	MEDIUM	FINE	SILT	CLAY
0.0	0.0	1.6	1.0	1.9	3.2	33.5	58.8

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
3/8 in.	100.0		
#4	98.4		
#10	97.4		
#40	95.5		
#100	93.3		
#200	92.3		

* (no specification provided)

Material Description

Elastic Silt

Atterberg Limits

PL= 34 LL= 66 PI= 32

Coefficients

D_{85}= 0.0477 D_{60}= 0.0066 D_{50}= 0.0026
D_{30}= D_{15}= D_{10}=
C_u= C_c=

Classification

USCS= MH AASHTO= A-7-5(36)

Remarks

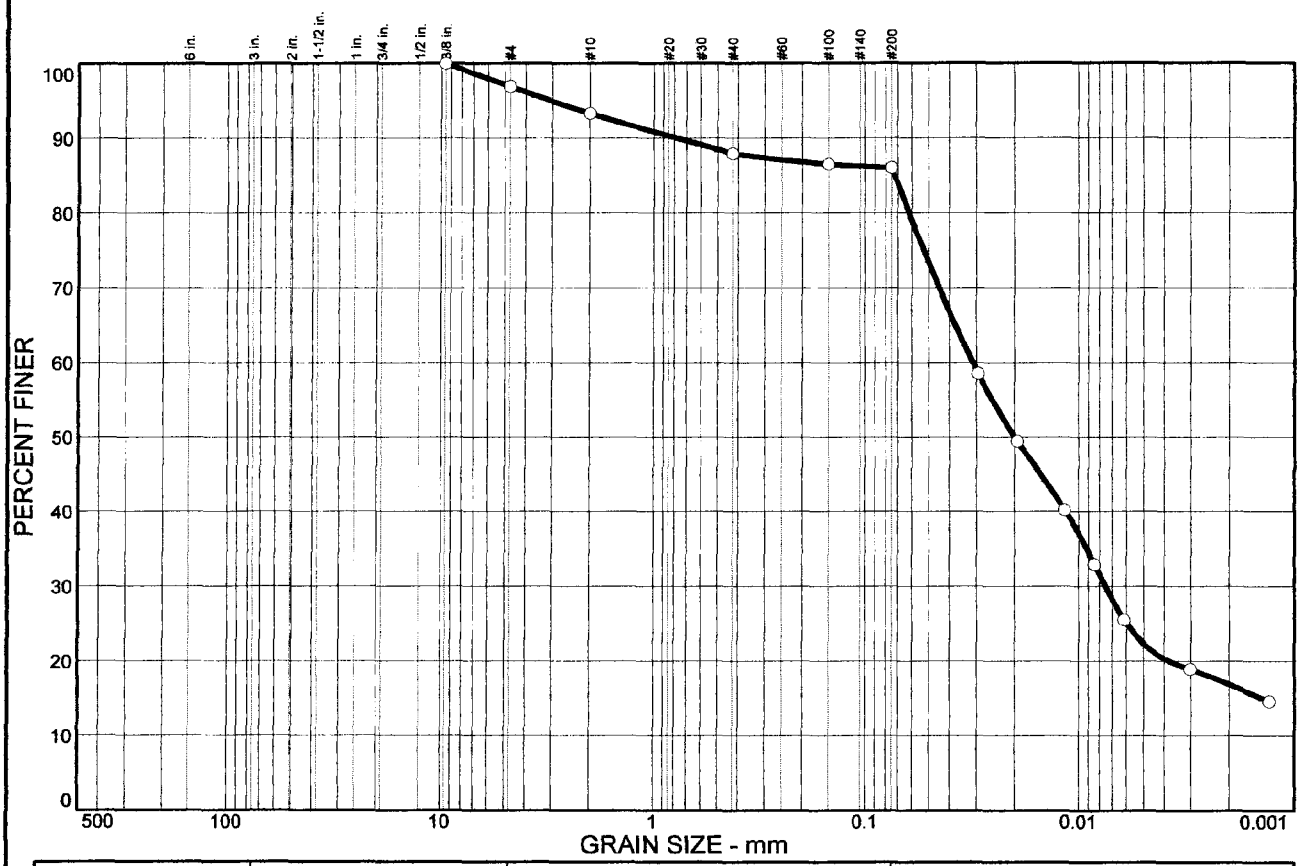
A Specific Gravity of 2.74 was assumed for Hydrometer calculations
F.M.=0.08

Sample No.: **Source of Sample:** **Date:**
Location: B-6 Sample #4 **Elev./Depth:**

GREGG LABORATORIES, INC.

Client: GRW Engineering
Project: Todds Road Bridge
Project No: 06-048 **Figure**

Particle Size Distribution Report



% COBBLES	% GRAVEL		% SAND			% FINES	
	CRS.	FINE	CRS.	MEDIUM	FINE	SILT	CLAY
0.0	0.0	3.1	3.6	5.4	1.9	63.7	22.3

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
3/8 in.	100.0		
#4	96.9		
#10	93.3		
#40	87.9		
#100	86.5		
#200	86.0		

* (no specification provided)

Soil Description

Silt

Atterberg Limits

PL= 31 LL= 34 PI= 3

Coefficients

D_{85}= 0.0727 D_{60}= 0.0313 D_{50}= 0.0200
D_{30}= 0.0075 D_{15}= 0.0014 D_{10}=
C_u= C_c=

Classification

USCS= ML AASHTO= A-4(4)

Remarks

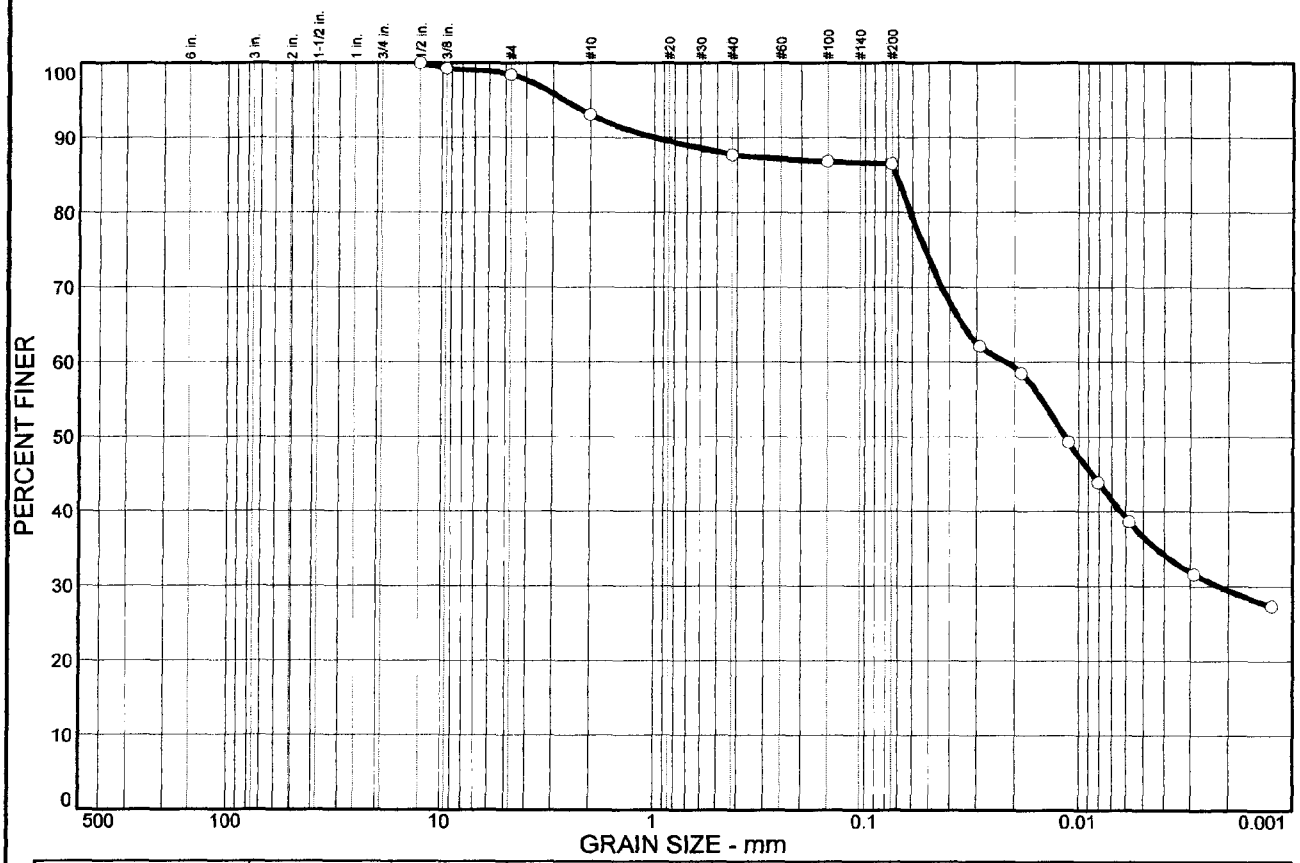
A Specific Gravity of 2.74 was assumed for Hydrometer calculations
F.M.=0.17

Sample No.: **Source of Sample:** **Date:**
Location: B-11 Sample #1 **Elev./Depth:**

GREGG LABORATORIES, INC.

Client: GRW Engineering
Project: Todds Road Bridge
Project No: 06-048 **Figure**

Particle Size Distribution Report



% COBBLES	% GRAVEL		% SAND			% FINES	
	CRS.	FINE	CRS.	MEDIUM	FINE	SILT	CLAY
0.0	0.0	1.6	5.3	5.4	1.2	49.9	36.6

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
1/2 in.	100.0		
3/8 in.	99.3		
#4	98.4		
#10	93.1		
#40	87.7		
#100	86.8		
#200	86.5		

* (no specification provided)

Soil Description

Lean Clay

Atterberg Limits

PL= 23 LL= 43 PI= 20

Coefficients

D_{85}= 0.0717 D_{60}= 0.0220 D_{50}= 0.0116
D_{30}= 0.0022 D_{15}= D_{10}=
C_u= C_c=

Classification

USCS= CL AASHTO= A-7-6(18)

Remarks

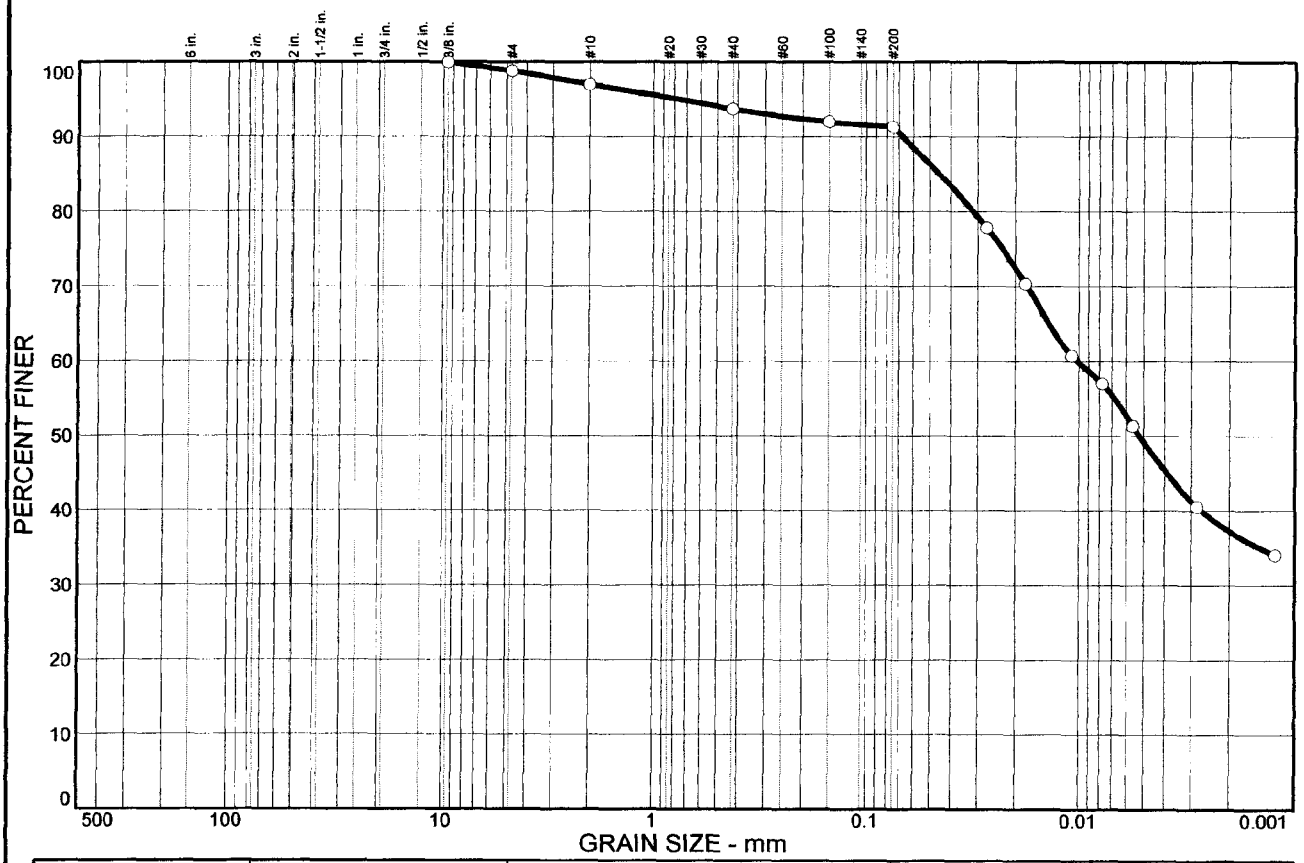
A Specific Gravity of 2.74 was assumed for Hydrometer calculations
F.M.=0.16

Sample No.: **Source of Sample:** **Date:**
Location: B-11 Sample #3 **Elev./Depth:**

GREGG LABORATORIES, INC.

Client: GRW Engineering
Project: Todds Road Bridge
Project No: 06-048 **Figure**

Particle Size Distribution Report



% COBBLES	% GRAVEL		% SAND			% FINES	
	CRS.	FINE	CRS.	MEDIUM	FINE	SILT	CLAY
0.0	0.0	1.2	1.8	3.3	2.4	42.1	49.2

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
3/8 in.	100.0		
#4	98.8		
#10	97.0		
#40	93.7		
#100	92.0		
#200	91.3		

* (no specification provided)

Soil Description

Fat Clay

Atterberg Limits

PL= 27 LL= 51 PI= 24

Coefficients

D_{85}= 0.0454 D_{60}= 0.0102 D_{50}= 0.0052
D_{30}= D_{15}= D_{10}=
C_u= C_c=

Classification

USCS= CH AASHTO= A-7-6(25)

Remarks

A Specific Gravity of 2.74 was assumed for Hydrometer calculations
F.M.=0.09

Sample No.: **Source of Sample:** **Date:**
Location: B-12 Sample #6 **Elev./Depth:**

GREGG LABORATORIES, INC.

Client: GRW Engineering
Project: Todds Road Bridge
Project No: 06-048 **Figure**

COORDINATE DATA SUBMISSION FORM
KYTC DIVISION OF MATERIALS - GEOTECHNICAL BRANCH

County: Fayette
Road Number: Todds Road Widening - Todds Road over I-75
Survey Crew / Consultant: GRW Engineers, Inc.
Contact Person: Greg Gabbard
Item No.: 7-225.00
Mars No.:
Project No.: N/A

Date: 10/27/06

Notes: Borings with "CH" and "AH" designations are from the 1961 geotechnical exploration of the Todds Road over I-75 Bridge.

(select one) **Elevation Datum** **Sea Level** **Assumed**

HOLE NUMBER	STATION	OFFSET	ELEVATION (ft)	LATITUDE	LONGITUDE
B-6	105+28.5	24.5' Rt.	1048.4	37.99608712	84.39644049
B-8	106+00.0	45.0' Rt.	1019.3	37.99618735	84.39666539
B-11	108+05.0	66.9' Lt.	1035.2	37.99601876	84.39744733
B-12	108+50.6	24.0' Rt.	1042.2	37.99629059	84.39752823
CH-2	108+27.1	2.0' Lt.	1029.7	37.99620619	84.39746979
CH-3	107.72.7	26.0' Rt.	1026.5	37.99624640	84.39726365
CH-6	106+69.3	5.4' Rt.	1030.2	37.99612562	84.39693115
CH-7	105+98.2	25.9' Rt.	1029.4	37.99613518	84.39667466
CH-10	105+10.6	2.0' Lt.	1033.6	37.99600495	84.39640136
AH-4	106+45.1	9.1' Lt.	1029.9	37.99607150	84.39686110
AH-5	105+85.6	26.9' Rt.	1026.6	37.99612984	84.39663132
AH-8	105+74.5	2.5' Lt.	1031.1	37.99604424	84.39661747